

ON THE TREATMENT OF CONSONANT CLUSTER REDUCTION

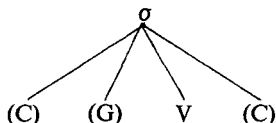
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In this paper we will consider a theory of Consonant Cluster Reduction (CCR) without deletion rules. Through its analysis of CCR and closely related phenomena in the phonology of Korean, this paper explains why CCR should be dealt with by a general convention which we shall refer to as Stray Erasure Principle. It will be shown that, though primarily based on the Korean language, this theory makes correct predictions about similar phenomena in other typologically unrelated languages such as Menomini.

1. The Syllable Structure of Korean

The phonemic inventory of Standard Korean comprises 9 (or 10) vowels and 21 consonants including glides.¹ At the phonetic level, only a limited number of consonants (i.e. [p^h], [t^h], [k^h], [l], [m], [n] and [ŋ]) are allowed in the syllable-final position because of Obstruent Neutralization. However, all the consonants can in principle occur both morpheme-initially² and morpheme-finally provided we admit that there are some accidental gaps for some reason or other. True consonants can also occur before an on-glide *y* or *w*. The canonical syllable structure of Korean would then look like this:

(1)



Since we do not find evidence supporting the syllable-internal hierarchical structure, we will take no account of the possibility of assigning *G* either to the onset (cf. B.-G. Lee 1982) or to the nucleus, which in turn is dominated by an upper node, namely the rime. Instead, we will adopt the basic idea of Clements and Keyser (1983), which is minimally different from the theory developed by Kahn (1976) in that it recognizes an intermediate CV tier between the syllable (σ) and the phonemic melody

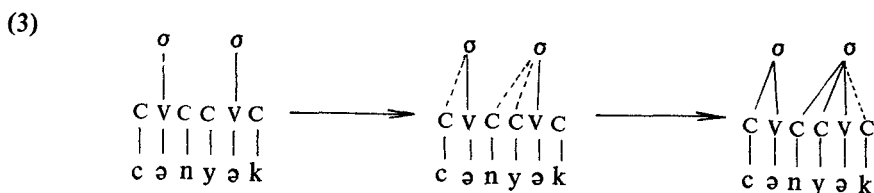
¹ It has been taken for granted by many grammarians that vowel length is distinctive in the Seoul dialect (H.-B. Choi 1955; Ramstedt 1939; K.-W. Nam 1954, 1955; K.-M. Lee 1972; W.-J. Kim 1971; Kim-Renaud 1974) and that the distinctive length of Standard Korean corresponds to distinctive pitch accent or a combination of pitch and length in certain areas of Korea (Martin 1954; Y.-C. Chung 1974; W. Huh 1965). For the purpose of this paper, however, vowel length will be ignored, since the length distinction seems to be no longer valid in present-day (Standard) Korean.

² It is claimed by Martin (1954: 20) that there is only one morph beginning with η : *ŋaci* 'offspring' in the three words *soŋaci* 'calf' (*so* 'cow'), *kaŋaci* 'puppy' (*ke* 'dog'), and *maŋaci* 'colt' (*mal*, *ma* 'horse'). Historically, but not synchronically, this η is one of the epenthetic segments for avoiding the hiatus (cf. *pakaci* 'half gourd' (*pak* 'gourd'), *mokaci* 'neck' (Pej.) (*mok* 'neck').

(cf. McCarthy 1979a, 1981), and propose the following syllabification rules for Korean:³

- (2) a. V-elements are prelinked to σ 's.
- b. C-elements to the left are adjoined one by one as long as the second C is [-cons, -voc, +high].
- c. Subsequently, let a C to the right, if there is one, be anchored onto σ .

As a matter of fact, (2) is nothing but a language-specific interpretation of the Onset First Principle (Clements and Keyser 1983: 37). The following example (*cənyək* 'evening') illustrates the algorithm:



Here we are assuming the feature percolation constraint (4) (Halle and Vergnaud 1978):

- (4) If a node in a tree is labeled with a particular feature or feature complex, then all segments dominated by the node in question must possess the feature or features.

To use the terminology of Clements and Keyser, this simply means that vowels are anchored to V-elements of syllable structure and consonants to C-elements of syllable structure.⁴ The representation of glides as C's in (1) acknowledges the idea that the basic repertoire of underlying and surface syllable types of a given language are essentially the same (cf. McCarthy 1979b).

2. Consonant Cluster Reduction

Not infrequently certain Korean morphemes have extrasyllabic elements, which are heard before certain vowels, e.g. the copula *i* and vowel-initial inflectional endings like the subject marker (SM) *-i* and the infinitive *-ə*. For example, *kaps* 'price' is reduced to *kap* syllable-finally (i.e. before a consonant or a # boundary): *kaps-to* [kap=t'o] 'price too'; *kaps-man* [kamman] 'just the price'; *kaps-əc'i* [kabəč'i]

³ Elimination of the feature [syllabic] originally proposed in SPE to facilitate the treatment of the French liaison has been argued for fairly convincingly by Clements and Keyser (1982, 1983).

⁴ Needless to say, trees are subject to the well-formedness conditions (Halle and Vergnaud 1978) or the universal association convention (cf. Goldsmith 1976; Clements and Ford 1979; Pulleyblank 1983), which we will not repeat here.

'worth.' Compare *aps-ə* [əp̚s̚ə] 'not having'; *kaps-i* [kap s̚i] 'price-SM'.⁵

A list of possible morpheme-final sequences is given in (5):

- (5) a. p(s) N: kaps 'price'
 p(s) V: əps- 'have not'; kayəps- 'be pitiful'
 k(s) N: saks 'wage, fare'; nəks 'spirit'; moks 'share'
 n(c) V: anc- 'sit'; ənc- 'load'; k'iənc- 'shower (over)'
 l(t^h) V: halt^h- 'lick'; hult^h- 'strip off'
- b. (l)k N: hilk 'earth, soil'; c^hilk 'arrowroot'; talk 'hen'; k'atalk
 'reason'
 V: ilk- 'read'; nalk- 'be worn-out'; nilk- 'be old'; malk- 'be
 clear'; mulk- 'be watery, thin'; kulk 'be big and round';
 kalk- 'nibble, scrape'; kilk- 'scratch'; palk- 'be bright,
 dawn'; pulk- 'be red'; olk- 'snare'; əlk- 'tie up, be
 pockmarked'
- (l)m N: salm 'life'; alm 'knowing, knowledge'
 V: salm- 'boil'; talm- 'resemble'; cəlm- 'be young'; kolm-
 'fester, have pus'; kulm- 'go without food'; olm- 'be in-
 fected (by), move'; cilm- 'bundle up to carry'
- (l)p V: palp- 'tread (on)'; yalp-/yəlp- 'be thin'; nəlp- 'be wide';
 c'alp- 'be short'; t'əlp- 'be astringent, puckery'
- (l)p^h V: ilp^h 'recite (a poem)'
- c. lh V: silh- 'hate'; ilh- 'lose'; talh- 'wear out'; olh- 'be right';
 k'ulh- 'kneel'; k'ilh- 'boil'; t'ulh- 'penetrate, bore'; kolh-
 'go bad, go hungry'
- nh V: manh- 'be many/much'; k'inh- 'cut'

(5c) will be dealt with separately in section 3. If we look at the first two cases (5 a,b), we might be tempted to conclude that in clusters the last coronal consonant is deleted. Excepted is *yətəlp* [yədəl] where restructuring seems to be underway (cf. *tols* [tol]). This would account for the reason why in (5b) the first consonant is deleted, since *l* is a coronal and the following consonants are not, and why in (5a) the second of the clusters delete. It would also account correctly for the

⁵ In the case of nouns, the reduced forms seem often to be reinterpreted as if they were basic, so that [kabi] (instead of the standard [kap̚s̚i]) is also used in the colloquial. The extreme case is the orthographic *ls* as in *tols* 'first anniversary (of one's birth)', which is invariably pronounced *tol* even before a subject marker (SM) *i*. Another note is in order. On the whole, the Korean speaker is not as conscious of Obstruent Voicing as is indicated in the phonetic description. The same seems to hold true for postlexical Palatalization. Other phonological rules worthy of note here are: Nasalization [- cont] → [+ nas]/_____ [+ nas], and Fortition (to be discussed below).

*l*th clusters in which the *l*th, rather than the *l* deletes. This generalization can be expressed as follows:

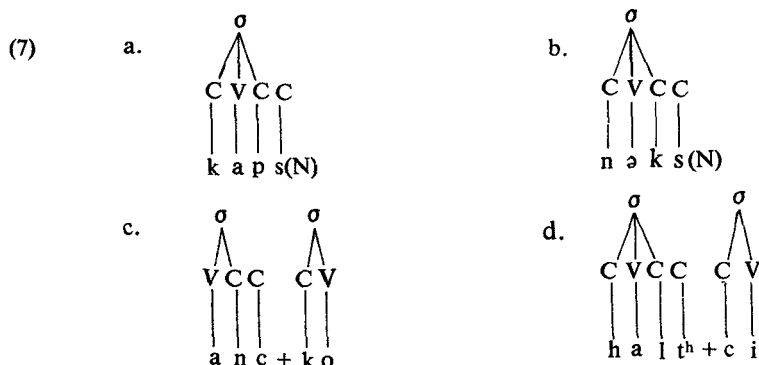
(6) Consonant Cluster Reduction (CCR)⁶

$$\left[\begin{array}{c} \text{C} \\ + \text{cor} \end{array} \right] \longrightarrow \phi // \text{C} _____ / _____.$$

Rule (6) reads: a coronal consonant is deleted after or before another consonant in the environment of the following syllable boundary. However, (6), while it can be made to work, cannot provide the basis for an explanation of the phenomenon. In particular, it is difficult to see what it is about the nature of the feature coronal which could account for the existence of this rule. A correct account of CCR, we believe, is to be sought not in a rule such as (6), but in the characteristic of the ends of Korean syllables. As is pointed out by Kim-Renaud (1974: 135), Korean speakers have an articulatory tendency not to release the syllable-final consonants. The consequence of a general unrelease of final consonants will be that in syllable-final stop clusters, only the first consonant will have an identifiable acoustic effect. If the first consonant is a stop, the oral cavity will necessarily be closed completely. Since it is impossible to move on to the next sound without releasing the stop consonant, this alone suffices to explain the reduction of the syllable excess in (5a), with the exception of the *l*th case. If, on the other hand, the first member of a cluster is a liquid *l*, the airflow through the oral cavity is not completely shut off, and the unreleased second member will then have a discernible acoustic effect. In the case of *l*th, one can hardly pronounce the two segments of the same point of articulation without releasing the second stop. Nevertheless, this should not be taken as evidence for the pronounceability of *l* + stop sequences in the syllable-final position (cf. Kim-Renaud 1974: 137, 144); the syllable structure of Korean does not permit such final clusters.

Though not expressed in (6), the liquid *l* is optionally deleted if it is followed by a noncoronal stop in a verb: *ilk-ko* [ilk'o] ~ [ik=k'o] 'reading'; *palp-ko* [palk'o] ~ [pap=k'o] 'tread (on) and'; *ilp^h-ko* [ilk'o] ~ [ip=k'o] 'recite (a poem) and.' We can of course handle the case by stating a condition on the rule. Admittedly, rule (6) (with a condition added) is a fine solution, but it fails to explain why, in actuality, the alternative pronunciations are more acceptable to most speakers. Thus, the clusters with *l* must have a separate explanation from the stop-initial clusters. We return to the clusters with *l* below, but first suggest a formal mechanism to account for the clusters of (5a). Suppose the syllabification principles of Korean apply to (5a). This will yield:

⁶ For the interpretation of "mirror image convention" as opposed to Bach's (1968) "neighborhood convention," see Langacker (1969) and Anderson (1972).



In (7), syllabification should proceed as dictated by the rules in (2).

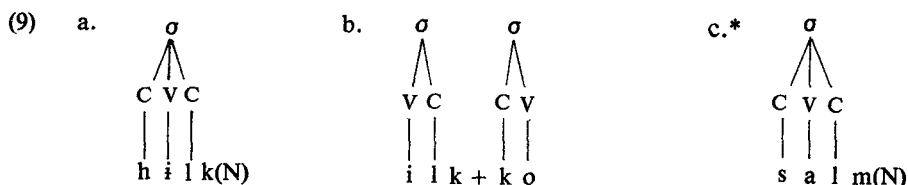
The pairwise left-to-right association does not associate the rightmost consonant. At this point we need not worry about the coronality of the unassociated consonant (but see below). The extrasyllabic (or unsyllabifiable) elements are to be reduced in the long run. Looked at in this way, reduction of the second member of a consonant cluster is a consequence of syllabification. The extrasyllabics are considered to be erased by the following convention which, in some sense, is in the same vein as Clements and Ford's (1979) treatment of an unassociated element and McCarthy's (1981) prohibition against many-to-one associations:

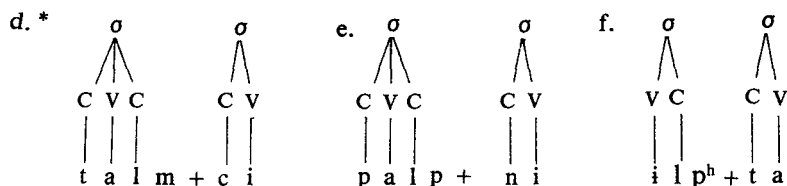
(8) Stray Erasure Principle (SEP)

Segments not integrated into the syllable are erased at the end of the derivation.

The role of extrasyllabicity has been discussed in Halle and Vergnaud (1978) and also Clements and Keyser (1982, 1983), but all of the cases exemplified there happen to be ones in which floating segments are rescued by rules like epenthesis. According to the Exhaustive Syllabification Convention proposed by Selkirk (1981), all segments within the domain of syllabification are analysed in syllable structure (by using "dummy" elements, if necessary). But these proposals do not hold true for languages like Menomini and Korean. As pointed out by Bley-Vroman (personal communication), it rather looks like the way languages treat unsyllabified elements may be subject to "parametric variation." Our concern here is, therefore, how to deal with CCR in languages that are apparently in need of such a rule.

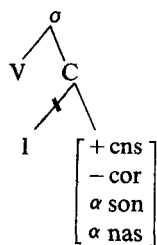
Returning now to the clusters in (5b), the syllabification conventions would apply to them as follows:





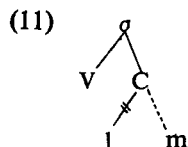
The SEP predicts that in all these clusters, the second will delete. In fact, the prediction does not hold in the case of the *lm*-clusters. The situation in Standard Korean is somewhat complicated. There (9c, d) are impossible, but in the other cases, while (9a) is seldom, if ever, used, either the liquid *l* or a stop is deleted, though preference may differ from speaker to speaker. These facts can be expressed as the following language-specific resyllabification rule:⁷

(10) Consonant Cluster Reduction



Condition: Obligatory if +N or $\alpha = +$,
and optional otherwise.

We note, however, a dialect development in the direction of greater simplicity, consistent with the prediction of SEP. Save for the *lm*-sequence in which *m* remains, it is always the second (i.e. extrasyllabic) consonant that gets reduced in most of the Kyōngsang areas. To get the *lm*-sequence to come out right, we propose rule (11) for this particular dialect:



Again, the disassociated *l* will eventually be erased by SEP (8).

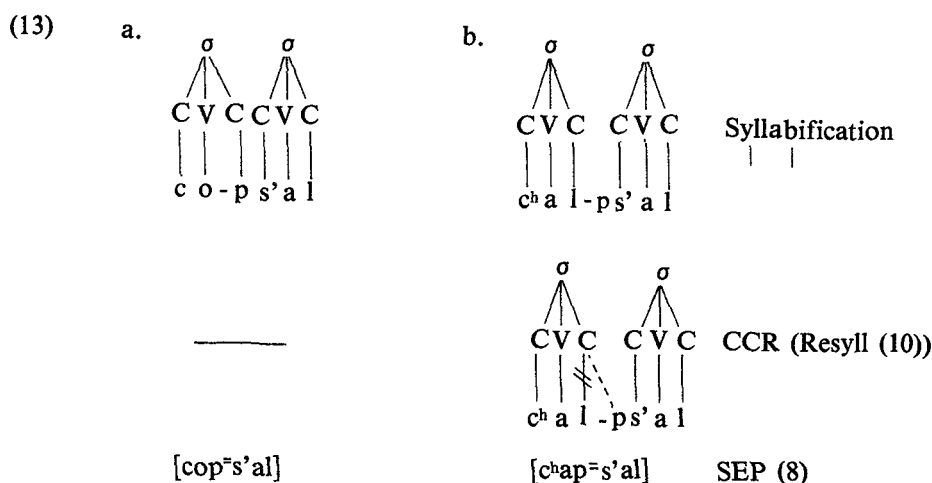
If we turn our attention to the initial part of a morpheme, we find analogous but even more interesting sequences of consonants:

⁷ As we shall see in §3, (10) should be ordered after a rule of aspiration. Following Steriade (1982) and Kiparsky (personal communication), we will assume that syllabification rules are also to be ordered along with other phonological rules (cf. McCarthy 1979b: 453).

- (12) a. *ps'*: *co-ps'al* 'hulled millet' (*co* 'millet' + *s'al* 'rice' (MK *psal*); *i-ps'al* 'plain rice'; *me-ps'al* 'nonglutinous rice'; *ch'al-ps'al* [*ch'ap*=*s'al*] 'glutinous rice' *pyə-ps'i* 'rice seed' (*s'i* 'seed' (MK *psi*))
- hü-ps'a-* 'wrap up, surround' (*hü* 'around' + *s'a-* 'wrap' (MK *psa*)); *cə-ps'a-* 'be agile' (*cə* 'be swift' + *s'a-* 'be quick'); *hü-ps'il-* 'sweep (off)' (*s'il-* 'sweep' (MK *psil*))
- b. *pc'*: *i-pc'ak* 'this side' (*i* 'this' + *c'ak* 'side' (MK *pcak*)) *cə-pc'ak* 'the other side'
- c. *pt'*: *i-pt'e* 'this time' (*t'ε* 'time' (MK *ptε*)); *cə-pt'e* 'the other day'

Besides the CG sequences, there are, to our knowledge, only three kinds of consonant clusters at the beginning of certain morphemes, as can be seen in (12). By coincidence, all of them begin with a *p*: *ps'*, *pc'*, and *pt'*.

How our theory of the syllable can handle these sequences is shown in (13):



Notice that (2b) does not allow *p* to be incorporated into the second syllable. When isolated, *ps'al* can be nothing else but *s'al*, since there is no way of syllabifying *p* to the exclusion of *s'*. Thus, no special deletion rule is required. The operation of the syllabification rules (2) together with the stray erasure principle accounts for the facts.

2.1 'Bindungs *s*'

The 'Bindungs *s*,' also called the epenthetic *t* or *sai sios*, stemmed from a genitive marker *-s* of MK (with several positional variants) which was once used with an honored or inanimate possessor as opposed to *-ai/ -ii* for an animate possessor noun (S.-N. Lee 1954; B.-H. Ahn 1978; K.-M. Lee 1972). It is now best viewed as a kind of "morphological glue" which is present in certain forms, but in others, without being analyzable as a uniform meaningful entity. Some examples of it appear in (14):

- (14) a. ne-ka [nɛt^hk'a] 'riverside'⁸
 c^ho-pul [c^hot^hp'ul] 'candle light'
 tatimi-tol [tadimit^ht'ol] 'fulling block'
 pɛ-noli [pennori] 'boating'
- b. san-sɛ [sans'ɛ] 'mountain birds'
 pom-pi [pomp'i] 'spring rain'
 coŋ-soli [coŋs'ori] 'sound of a bell'
 pul-kil [pulk'il] 'flame'

In (14) *t*-insertion appears to be limited to cases in which the first stem ends in a sonorant and the second begins with a lenis consonant:

(15) *t*-Insertion (Kim-Renaud 1974)

$$\emptyset \rightarrow t / [+son] \text{ ____ } \zeta \begin{bmatrix} +cns \\ -tns \end{bmatrix} \quad (\zeta = \text{compound boundary})$$

However, there are too many exceptions to rule (15). Since the 'Bindungs *s*' is bound up with the overall fortition phenomenon, it would be worthwhile to list all types of fortition along with some relevant examples before we view it from a different angle:

(16) FORTITION

- a. $[-son] \rightarrow [+tns] / [-son] \text{ ____ }$
 nɛlp-ta [nɛlt'a] ~ [nɛp^ht'a] 'to be wide'; cok-po [cok^hp'o]
 'genealogical table'; os-kis [ot^hk'it^h] 'the collar of a coat';
 k'ək'-sɛ [k'ək^hs'ɛ] 'cramp iron'; nac-cam [nat^hc'am] 'nap,
 siesta'
- b. $[-son] \rightarrow [+tns] / [+nas] \text{ ____ }$
 kam-ca [kamc'a] 'let's wind'
 sum-ki [sumk'i] 'hiding'
 an-ta [ant'a] 'to hold in one's arms'
- Cf. kamca [kamja] 'potato'; sal-ki [salgi] 'living'
- c. $\begin{bmatrix} -son \\ +cor \end{bmatrix} \rightarrow [+tns] / [+lat] \text{ ____ }]_{SK}$
 mol-tu [molt'u] 'absorption'
 kəl-sik [kəls'ik^h] 'begging'

⁸ The epenthesized *t* is usually deleted before a fortis obstruent in normal conversation.

nal-co [nalc'o] 'invention; fabrication'

Cf. mol-kak [molgak²] 'disregard'; palpyəŋ [palbyəŋ] 'outbreak of a disease'

- d. [-son] → [+tns] / X [+lat] [N ____]
where X = Verb stem.

k'oc-il tɛ [k'oɟilt'ɛ] 'ramrod' (k'oc- 'insert')

ka-l kos [kalk'ot²] 'place to go' (ka- 'go')

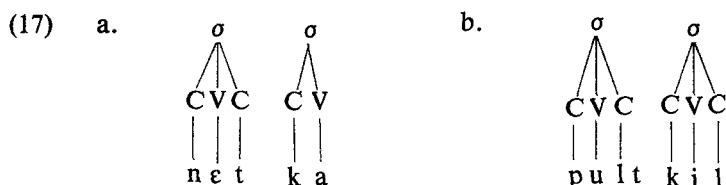
titi-l paŋa [tidilp'aŋa] 'tread mill' (titi- 'step on')

c^ham-il səŋ [c^hamils'əŋ] 'patience' (c^ham- 'be patient')

sə-l cali [səlc'ari] 'standing room' (sə- 'stand')

Of these, (16a) is the most general rule that is absolutely free from exceptions. On the other hand, fortition after a nasal (b) or / (c,d) is confined to certain morphological contexts. Given (16), however, no fortition is expected to take place in ordinary compound nouns (14) whose first members end in nonobstruents. To put it differently, forms like [nɛt'k'a] (nɛ 'brook, river'; ka 'border, side') *pul-kil* [pulk'il] 'flame' cannot be obtained without the prior application of *t*-insertion (cf. *nɛ-ka* [nɛga] 'I-SM'; *pul-kil* [pulgil] 'bad omen').

As the term 'morphological glue' implies, the major function of the 'Bindungs *s*' is to augment the degree of combination of two stems (or words) so that they may look more like compound nouns. It is our view, therefore, that there can be no difference between (14a) and (14b). Suppose *t*-insertion, whatever the form,⁹ has been applied to 'riverside' and 'flame,' to give *nɛ-t-ka* and *pul-t-kil*, respectively. The former can, of course, be easily integrated into the syllable structure of Korean, but the latter has to leave the epenthesized stray *t* as in (17b):



The stray segment *t* will be erased in the end subject to SEP; however, it leaves its trace by triggering Fortition (16a) in the following lenis obstruent. This is quite analogous to the fortition as in *nəlp-ta* [nəlt'a] 'to be wide' (16a), *halt^h-ko* [halk'o] 'lick and,' *ilh-ki* 'reading (cf. *il-ki* 'springing up; washing; diary; weather,' *ilh-ki* [ilk^hi] 'losing'). So the 'Bindungs *s*' seems to be 'real' in (17).

3. Aspiration: Another Look

So far, we have not taken (5c) (i.e. the lack of cluster simplification for root-

⁹ For a detailed discussion of the morphemic status of 'Bindungs *s*,' the reader is referred to Y.-S. Kim (1984).

final *nh*, *lh*) into account because /h/ is rather peculiar in the phonology of Korean: (i) it is often deleted intervocalically, especially when it occupies a morpheme-final position; (ii) it is idiosyncratically realized as [t] if not released—a case of neutralization; and finally, (iii) if it either precedes or follows a lenis stop, the stop becomes aspirated. And it is the last point (aspiration) that we seek to clarify in this section. A rule of Aspiration could be formulated as follows:

(18) Aspiration

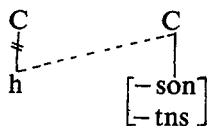
$$\begin{array}{ccc} \begin{array}{c} [-\text{son}] \\ [-\text{tns}] \\ 1 \end{array} & \begin{array}{c} h \\ 2 \end{array} & \rightarrow \begin{array}{c} 1 \\ [+ \text{asp}] \end{array} \quad \phi \quad (\text{mirror image}) \end{array}$$

And examples follow in (19):¹⁰

- (19) cəp-hap[cəp^hap =] 'union'
 t^has-ha-[t^hat^ha] 'blame'
 mac-hi-[mač^hi] 'hit (the mark)'
 kuk-hwa[kuk^hwa] 'chrysanthemum'
 silh-pi-[silp^hi] 'be sad'
 coh-ta[cot^ha] 'be good'
 noh-ca[noc^ha] 'let's put'
 anh-ko[ank^ho] 'do not and'

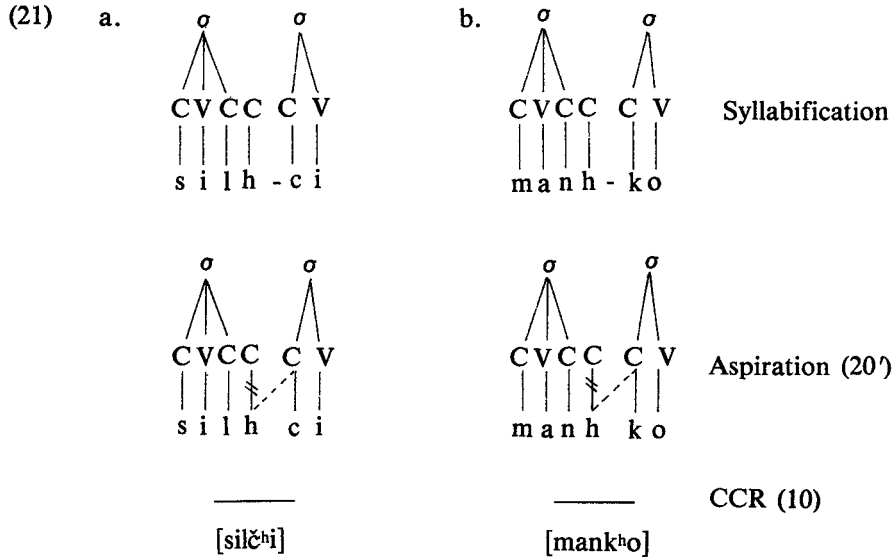
It appears that (19) shows a perfect mirror image. A moment's thought, however, indicates that the first expansion of (19) is a nonrule in the sense of Harms (1978), whereas the second expansion is a "real" phonological rule. As noted before, no Korean obstruent is released at the end of a syllable; hence the neutralization of obstruents (except *h*; see above) into homorganic lenis stops. Thus, when the following *h* is produced, the stop is still being held. It is natural that release of the blocked intraoral airflow with simultaneous glottal friction should result in aspirated stop sounds. If one thinks about English (e.g. *public house*, *LISP-hacking*), one will be further convinced. The idea of rule (18), therefore, lies rather in the fact that, unlike English, aspiration indeed has functional forces and therefore is distinctive in the Korean obstruent system. Thus, we simply restate (18) as (20):

(20) Aspiration (mirror image)



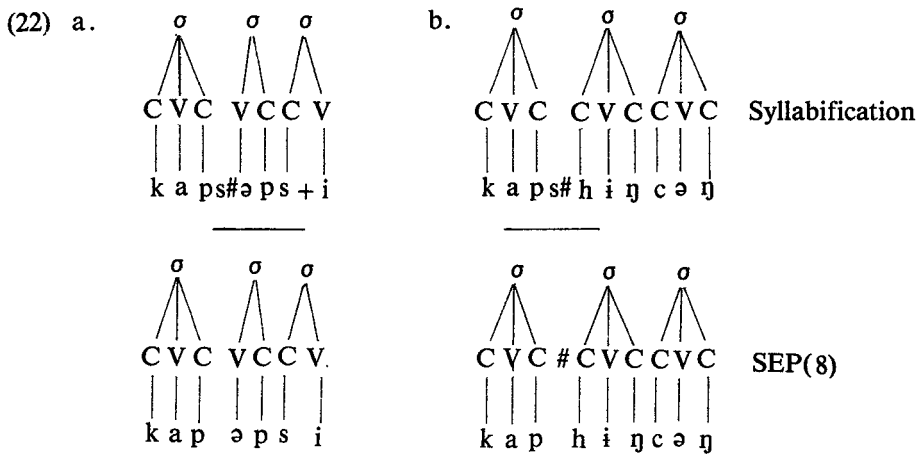
¹⁰ The derivation of [t^hat^ha] goes as follows: t^has-ha > t^hat-ha (Neutralization) > t^hat^ha (Aspiration).

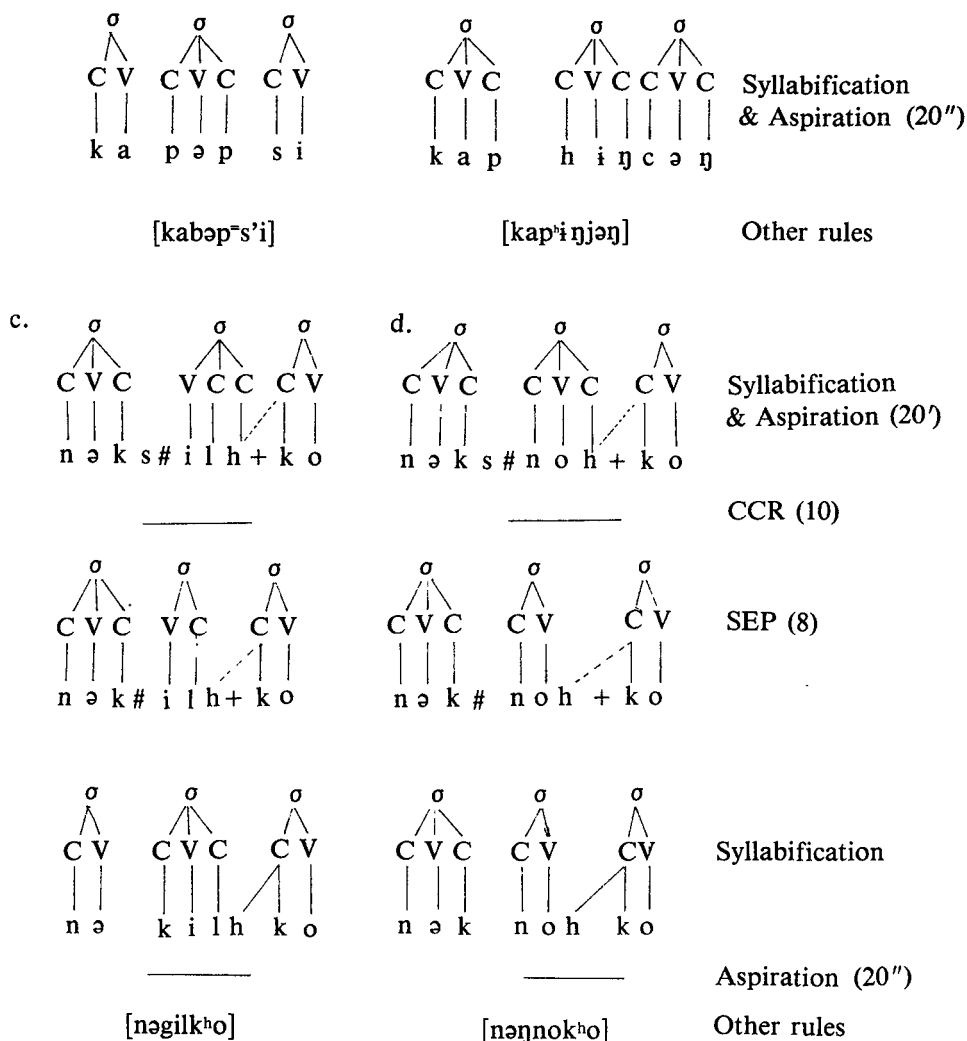
For convenience' sake, let us call the first expansion of this rule (20'), and the second expansion (20''). With this in mind, let us now look at two examples from (5c):



Under the first solution (18), Aspiration would have to be crucially ordered prior to CCR. However, (20) can obviate such a crucial ordering relationship because of the feature [+cons].

To show how CCR works with other phonological rules, we give the following derivations using *kaps#aps+i* 'worthlessly,' *kaps#hiŋcəŋ* 'a (price) bargain,' *nəks#ilh+ko* 'in raptures,' and *nəks#noh+ko* 'absent-mindedly':





It can be seen that SEP applies after (20') (22c, d) but before (20'') (22b). Also notice that SEP must be ordered before the post-cyclic rules, Obstruent Voicing (22a,c) and Nasalization (22d). Thus, we can draw two conclusions from (22). First, in Korean, SEP must apply at the end of the last cycle or at the word level; otherwise, the desired outputs would never be obtained. Second, as alluded to above, rule (20) in fact consists of two subrules: one applies lexically, and the other postlexically.

3.1 *a*-Deletion

The theory of aspiration we are assuming here can easily handle the *a*-deletion rule discussed in brief by B.-G. Lee (1982). In Korean, *-ha* is attached to another root (or stem) to form a verb or what B.-G. Lee calls a compound verb or adjective. With regard to productivity, nothing can be a match for *-ha*.¹¹ All in all, it is the only reliable resource for making loan words, be they Chinese or English, as well as certain native words undergo the Korean-particular verbal conjugation. For example, English loan words, whatever the original part of speech, can be used as verbs only through the *ha*-affixation: *liti-ha*- '(take the) lead'; *teitʰi -ha*- 'have a date' (cf. SK *yəne-ha*-); *hənsəm-ha* 'be handsome' (cf. Kor. *nɪls'in-ha*- 'be slender'). From this *-ha*, *a* is optionally deleted before suffixes which begin with a stop, but only in some set phrases¹²: *-ta*, *-ko*, *-ke*, *-ki*, *-ci*, *-ca*. That is, *a* is deleted only when the resultant string feeds into the rule of aspiration; otherwise it is not. So it is kept before *-si* (cf. *pyən-ha-si* 'change (Hon.)'; *pyən-ha-ci/pyən-h-ci* [pyənčʰi] 'change (Sus.)' or when *ha* is preceded by an obstruent (e.g. *tʰas-ha-ci* [tʰatʰaʃi] 'blame (Sus.)', *tok-ha-ke* [tokʰage] 'be noxious (Adv.)', *kətip-ha-ta* [kədipʰada] 'repeat (Dec.)'). The rule of *a*-Deletion may thus be stated:¹³

$$(23) \quad a \rightarrow \emptyset / [+son] \text{ h } ______]_v \begin{bmatrix} -son \\ -cnt \end{bmatrix}$$

Some of the data appear in (24):

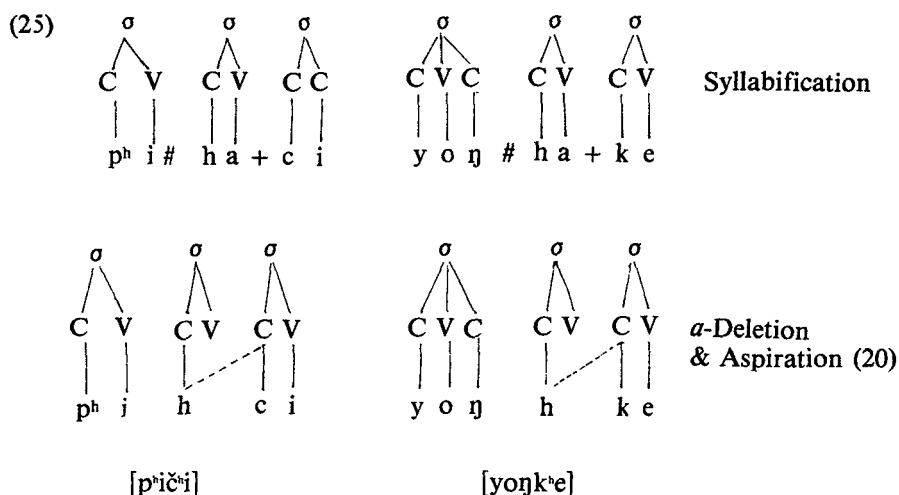
- (24) a. *mian-ha-ta/mian-h-ta* [mianʰa] 'be sorry (Dec.)'
 b. *pʰi-ha-ci/pʰi-h-ci* [pʰičʰi] 'escape (Sus.)'
 c. *yoŋ-ha-ke/yoŋ-h-ke* [yoŋkʰe] 'be admirable (Adv.)'
 d. *an-ha-ko/an-h-ko* [ankʰo] 'do not (Ger. 'and')'
 e. *myən-ha-ki/mən-h-ki* [myənkʰi] 'be exempted (Nom.)'

Given rule (23) and Aspiration (20), the derivations of (24b,c) are straightforward:

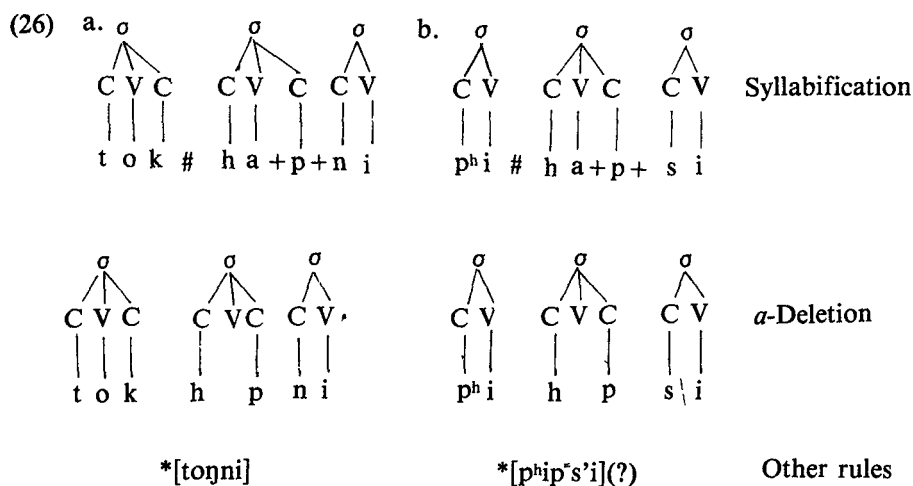
¹¹ The suffix *-ha* presents no immediate formal problem: it is segmentally discrete and immediately identifiable in most cases. The problem rather arises when we attempt to define its meaning or grammatical function. H.-B. Choi (1955) lists more than 13 grammatical functions of *ha*, depending upon whether it is used as a derivational suffix, or as a verb proper or an auxiliary verb. With such various functions, *ha* has been discussed by almost every grammarian including western scholars such as Ramstedt (1939: 66-67) and Martin (1954: 54). Though there have been pros and cons as regards H.-B. Choi's view, it is now the general opinion that *ha* also has its role to play in word formation. A notable exception is C.-S. Suh (1975), who denies *ha*'s function as a derivational suffix.

¹² As implied in "some set phrases," *-ha* does not always drop *a*: it should be retained in many other cases. It is to be noted in passing that the loss of *a* never happens in the verb *ha* meaning 'be plentiful' (e.g. *sutʰ-ha-ke* 'in abundance').

¹³ This is a minimally modified version of B.-G. Lee's rule, according to which the first part of its SD is [+seg]. This is due to his failure to notice that *a* is not deleted when *ha* is attached to a root (or stem) which ends in an obstruent.



As mentioned above, *ha* does not drop *a* when it is attached to a root (or stem) that ends in an obstruent. Nor is it dropped when it is followed by the humble ending *p* which in turn is usually followed by a consonant-initial suffix *-ni*, *-si*, or *-ti* (e.g. *p^hi-ha-p-si-ta* 'Let's escape,' *mian-ha-p-ni-ta* '(I) am sorry'). The reason is obvious: if it does, there will be no trace left of the verbalizer *-ha* due to CCR and Neutralization. The following derivations will clarify the point:



Notice that after *a* has been deleted, we get *tokhpni* and *p^hihpsi*, sequences that cannot possibly be integrated into the syllable structure. B.-G. Lee ascribes the ill-

formedness of such outputs as in (26) to the WFC imposed on the surface strings: Each segment is associated with at least one σ (cf. Kahn 1976). In other words, he claims that they are marked as structurally ill-formed by the WFC, since part of the strings are left unassociated. He thus uses this device, rather than the rule restriction to prevent the application of *a*-Deletion. But when we dealt with CCR, we argued that the stray segments are erased by SEP (8). So we must find a reason elsewhere.

To iterate the point, there is no way of syllabifying the whole strings in (26). Were the rule of Aspiration allowed to apply to (26b), its effect would be erased by Neutralization. It will appear then as if the verbalizer *-ha*, without which the nominal root *phi* would not be able to take conjugational endings, is not there at all. In the case of (26a), no trace whatsoever will be left of the verbalizer *-ha* and the humble *-p*, primarily due to CCR (i.e. SEP). This means that it has lost both the grammatically relevant information (i.e. *-ha* and *-p*) and the semantically relevant information (i.e. *-p*), which is unthinkable even in view of Kiparsky's (1972: 195) Distinctness Condition.

Far less obvious are those cases where aspiration takes place unexpectedly when two morphemes are adjoined. The most striking one occurs when a gender marker (*am* 'female' or *su* 'male') is prefixed to a noun:

- | | | |
|------|------------------|--|
| (27) | ke 'dog' | amk ^h e/suk ^h e |
| | tweci 'pig' | amt ^h weci/suth ^h weci |
| | talk 'hen' | amt ^h alk/suth ^h alk |
| | pəm 'tiger' | amp ^h əm/sup ^h əm |
| | kəs 'thing' | amk ^h əs/suk ^h əs |
| | tolc'əkü 'hinge' | amt ^h olc'əkü/suth ^h olc'əkü |
| | kiwa 'tile' | amk ^h iwa/suk ^h iwa |

Cf. *sus-kəs*[sut^hk'ət=] 'a naive person.' Given (27) and the independently motivated aspiration rule (20), it would perhaps be possible to suggest that *h* is there although it never surfaces even in an over-careful pronunciation. Supposing that the underlying forms of 'female' and 'male' are /amh/ and /suh/, respectively, then aspiration in (27) can be accounted for automatically. This supposition appears to be borne out by the data (28) as well:

- | | | |
|------|------------------|---------------------------------------|
| (28) | holan̄i 'tiger' | [amhoran̄i]/[suthoran̄i] |
| | oli 'duck' | [amori]/[sudori] |
| | sasim 'deer' | [amsasim]/[su(t ^h)s'asim] |
| | mal 'horse' | [ammal]/[sunmal] |
| | nom 'one; thing' | [amnom]/[sunnom] |
| | yəu 'fox' | [amnyəu]/[sunnyəu] |
| | ili 'wolf' | [amniri]/[sunniri] |

Since Korean has CCR and the intervocalic *h*-deletion rule, it is extremely difficult to see if *h* is really there in *am(h)*-X's. So we will focus on the treatment of the rightmost column in (28). Now look at the following (pretheoretic) derivations:

(29) a. /suh-holaŋi/	b. /suh-oli/	
t	t	<i>h</i> -neutralization
r	r	Delateralization
[sut ^h oraŋi]	[sudori]	Aspiration & Obstruent Voicing
c. /suh-mal/	d. /suh-yəu/	
t	t	<i>h</i> -neutralization
_____	n	<i>n</i> -insertion
[sunmal]	[sunnyəu]	Nasalization

Notice that in the derivation of the forms in (27), Aspiration must apply *before* *h*-neutralization, while it must apply *after* *h*-neutralization in (28). If one holds on to rule (18), one will certainly come up against an ordering paradox (cf. *suh-pəm* [sup^həm] vs. *suh-holaŋi* [sut^horaŋi]). These considerations forced Kim-Renaud to split the aspiration rule into two separate processes: progressive and regressive (1974: 122ff.). We have already noted that one of the aspiration rules may not be a phonological rule in the strict sense of the term. But there are reasons to believe that the phenomena so far considered in (27-28) are all high fossilized residues of historical change; the putative underlying forms are actually the same as historically prior *amh* 'female' and *suh* 'male.' The same is true of *anh* as in [anp^hak^h] (*an* 'inside,' *pak* 'outside'), *salk^hoki* 'red meat' (<*sal* 'flesh' + *koki* 'meat' (cf. *sal-kacuk* 'skin')), *map^halam* 'southerly wind' (cf. *palam* 'wind'), or perhaps *məlik^halak* 'a hair' (*məli* 'hair' + *kalak* 'division').

Granting that the *h* as in *anh* is not pronounceable in isolation because of the existence of CCR, *suh* at least should be pronounced *[sut^h] if it stands alone, or in phrases like *am-su* 'female and male' *[amsut^h], which is not the case.

An additional important fact about aspiration is that *c*-initial nouns do not undergo the rule after 'female' or 'male':

(30) cepi 'swallow'	amcepi/sutcepi
cine 'centipede'	amcine/sutcine
cū 'rat; mouse'	amcū/sutcū
coŋtali 'skylark'	amcoŋtali/sutcoŋtali

What is more, there seems to be a great variation in *kilin* 'giraffe,' *tok'epi* 'goblin,' *kəpuk* 'turtle,' *puəŋi* 'owl,' *toksuli* 'eagle,' *kəmi* 'spider,' *tuk'əpi* 'toad,' *kolilla* 'gorilla,' and so forth.¹⁴ Aspiration (18/20) as formulated is exceptionless, applying every time the structural description is met. Accordingly, adoption of these older underlying forms here would in return complicate the aspiration rule, yet leave a host of exceptions. We conclude, therefore, that *anh*, *amh*, and *suh* have only

¹⁴ It is strange that many speakers should pronounce the word for 'male crane' [sut^hak^h] (*hak* 'crane') which happens to be homonymous with [sut^hak^h] 'cock' (*talk* 'hen'). Probably this is due to the orthographic 'Bindungs s.'

historical interest: they cannot be regarded as underlying today as (31) clearly show

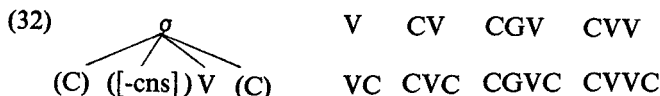
- (31) a. an(h)-pak' [an^hak] 'inside and outside'
 an(h)-kwa (pak') [angwa..] *[ank^hwa...]
 'inside and outside'
 Cf. anh-ko [ank^ho] 'do not and' (anh- 'do not')
- b. su(h)-holan̄i [sut^horaŋi] 'tiger'
 am(h)-su(h) han-s'aŋ [amsuhan..] *[amsut^han..]
 'a pair of female and male'
 Cf. talk han-s'aŋ [tak^hans'aŋ] 'a pair of hens'

In other words, *amh* and *suh* are only associated with Aspiration in fixed expressions and can only be given the same historical explanation as *anh*. In this respect they differ from the "unreasonable" aspiration occurring in *k^ho* (<*ko*) 'loop (of a string,' *k^han* (<*kan*) 'space,' and *k^halc^hi* 'hairtail' noted by H.-B. Choi (1955: 134),, who, however, treats the *h* as an infix—an unfortunate nomenclature in a case like this.

4. CCR: The Evidence from Menomini

This section seeks to show how the theory of CCR developed in the previous section is borne out by phenomena in the phonology of Menomini, a central Algonquian language spoken near Green Bay, Wisconsin.¹⁵

On inspection of the data given in Bloomfield (1939, 1962), it is not difficult to identify the canonical syllable structure of Menomini, which is represented as (32):



where VV stands for sequences of vowels, long vowels or diphthongs.

While a vowel is always preceded by a nonsyllabic *except* word-initially, the diphthongs occur almost exclusively after nonsyllabics.¹⁶ Now observe the following data taken from Bloomfield (1962: 87):

(33)	Root	Singular	Plural (-ak)
a.	a ^ʔ seny- 'stone'	a ^ʔ sen	a ^ʔ senyak
b.	mε ^ʔ tEkw- 'tree'	mε ^ʔ tek	mε ^ʔ tekok
c.	ahkehkw- 'kettle'	ahkε:h	ahkεhkok
d.	metemohs- 'woman'	metε:moh	metε:mohsak

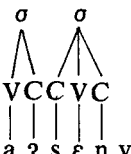
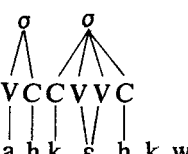
¹⁵ Citing the earlier version of this paper, McCarthy (1983) could give a neat account of Southern Paiute Reduplication. One can of course apply the theory to other better-known languages such as English, French, Icelandic and Catalan. Cf. Kiparsky (1983) and Clements and Keyser (1982).

¹⁶ The only exception is the form *uah* 'he uses it' (cf. *wa:h* 'fish egg') and a few inflectional forms derived from it.

- e. we:nana[?]s- 'dirty fellow' we:nana[?] we:nana:[?]sak

In Menomini there are very complicated rules which govern vowel quantity, rules which Miner (1981) calls Post-cluster Shortening (PCS), Second Syllable Lengthening (SSL), and the Even Syllable Rule (ESR).¹⁷ We will not go into the details, but it is to be noted in (33) that contrast between long and short vowels is underlying as well as derived.

Given (32), we can correctly syllabify the singular forms of (33a,c) as follows:

- (34) a.  c. 

As Bloomfield (1939: 359) puts it, "final nonsyllabics are dropped *until only one is left* (emphasis added)." Again, the question that naturally arises at this point is whether we are really in need of an "actual" phonological rule to drop a final consonant or consonants. Is there a place for Final Cluster Reduction (FCR) as an independent phonological rule in this language? Although it was necessary to formulate such a rule before the syllable was recognized as a necessary element in phonological descriptions, we would like to say that such a reduction of the syllable excess is simply in the charge of SEP, as argued before. Crucially, there are no apt cases that require FCR in the middle of the derivation of Menomini words (or sentences).

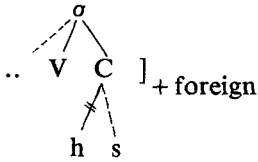
Bloomfield notes, however, that in a number of forms, thereby characterized as "foreign," the final *hs* is replaced by *s* (1962: 114-115):

- | (35) | Root | Singular | Plural |
|------|------------------------|------------|-----------------------------|
| | ko:hko:hs- 'pig' | ko:hko:s | ko:hko:hsak
~ko:hko:hsan |
| | semā:kanehs- 'soldier' | sema:kanes | sema:kane:hsak |
| | mo:hsw- 'moose' | mo:s | mo:hsak |
| | menehsy- 'island' | merie:s | mene:hsyan |

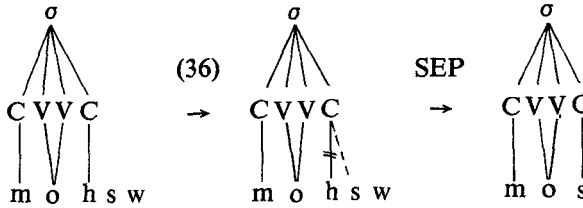
This marked case must be handled by a language-specific rule, which is similar in nature to the CCR of the Korean language (10):

¹⁷ For example, vowel quantity in (33) can be accounted for by SSL (c,d) and ESR (e). In addition, there is a fourth rule often called Monosyllable Shortening (e.g. *pe[?]t-e: pe:[?]c* (after Mutation & Apocope) 'accidentally, by error' (see (38a)). Incidentally, Bloomfield's formulation of alternation of vowel quantity in 1962 is wrong (Goddard, Hockett and Teeter 1972), even though the change from 1939 to 1962 was seen by Bloomfield as an improvement (Miner 1981).

(36) Foreign Reduction



(37)



A nontrivial note is in order. Unlike (33) and the foreign reduction (35), ?s is kept in two noun stems (38a), and ?s and ?c are kept in a number of particles (38b) (Bloomfield 1962: 88):

- (38) a. name: ?s - 'fish' name: ?s 'fish' name: ?sak 'fishes'
 -ki ?s - 'son' neki: ?s 'my son' neki: ?sak 'my sons'
- b. pe: ?c (from *pe: ?t-e*) 'accidentally;
 ceya: ?s (from *ceya: ?N-e*) 'by surprise'

Bloomfield (1962: 368) notes that particles are freely formed from roots by the addition of a zero suffix which demands mutation of the final *N* and *t* (to *s* and *c*, respectively) and which might be set up as *-e*. This "ghost" segment *e* will be deleted by Apocope, a later rule needed for Menomini, in any case. Given (38b) alone, one could account for these anomalous final clusters by ordering Mutation and FCR *before* Apocope. Compare:

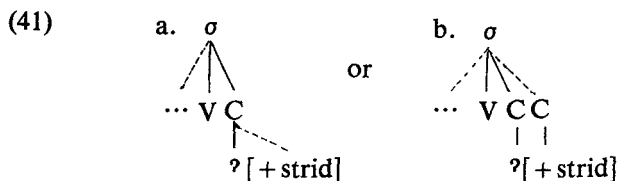
- | | | |
|------------------------|------------------------|----------|
| (39) a. 'dirty fellow' | b. 'by surprise' | |
| /we:nana ?s / | /ceya: ?N-e / | |
| — | s | |
| — | — | |
| | ϕ | |
| [we:nana ?] | [ceya: ?s] | Mutation |
| | | FCR |
| | | Apocope |

Both are correct surface forms, and it seems as though our claim in connection with (33) above is untenable. However, if we look at (38a), it seems possible to give a similar explanation, since Truncation ($\check{V} \rightarrow \phi // V + ______$) is well motivated in Menomini: *nona:kan* (<*none-a:kan-*) 'nipple, breast,' *watasam* (<*wata-Esam*) 'he cuts in a circle.' Such an explanation is, however, out of the question for the simple reason that */ne + ki ?N-e + ak/*, for instance, will be realized as **neki: ?sek* instead

of *neki sak*. So (39) is not the optimum solution even in light of (40) further noted by Bloomfield:

- (40) a. The *t* (or *c*) of final *-ʔt* is dropped in *apeʔ* 'it is wonderful' (<*apeʔt* -) and *meneʔ* 'in front, on ahead' (<*meneʔt*).
 b. Final *ʔc* is retained optionally in *me:ʔ*, *meʔc* 'till all is gone.'

However, no matter which treatment of (38) turns out to be correct, we must not overlook the fact that consonant clusters are retained on the surface that can not be integrated into the syllable structure (32). We do not want to allow final clusters in the basic syllable canon of Menomini. Instead we propose the special resyllabification rule (41), which applies only to lexically marked roots such as those in (38):¹⁸



Choice between (41a) or (41b) will be determined solely on the basis of the phonetic content of the final clusters. In the absence of evidence to the contrary, (41a) is the best choice because at least it does not violate the canonical syllable structure of the language.

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¹⁸ As suggested by Harms (personal communication), we may be seeing a change to a syllable structure with (41) as normal. Note that if (32) without (41) was original, the lost consonants are not likely to resurface with a change in syllable structure. But new forms would be free to retain final *ʔc*.

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